

Appl. No. : 10/821,580
Filed : April 9, 2004

AMENDMENTS TO THE CLAIMS

Please amend Claims 1, 7, 8, 12, and 14 as follows. Insertions are shown underlined while deletions are ~~struck through~~. Please add Claims 21 and 22.

1 (currently amended): A diversity antenna apparatus comprising:
a plurality of antenna elements disposed on a substrate; and
a ground pattern formed in or on the substrate, the ground pattern functioning together with each of the antenna elements;
wherein the ground pattern is formed at a central region of the substrate with a gap from each of the antenna elements, and wherein the antenna elements are disposed along outer edges of the substrate and/or the ground pattern so as to surround the ground pattern,

wherein the ground pattern has at least one side edge along which at least two of the antenna elements are disposed with tips thereof directed in the same direction and with spaces provided adjacent to and in the directions of the respective tips of the antenna elements.

2 (original): A diversity antenna apparatus according to Claim 1, wherein the antenna elements are disposed with mutual gaps that are not smaller than one quarter of a wavelength associated with a resonant frequency.

3 (original): A diversity antenna apparatus according to Claim 1, wherein the antenna elements are formed as rectangular chip antennas, the chip antennas being arranged in at least two arrangements including a first arrangement in which a chip antenna is disposed laterally along a first edge of the substrate, and a second arrangement in which a chip antenna is disposed longitudinally along a second edge of the substrate, the second edge being perpendicular to the first edge.

4 (original): A diversity antenna apparatus according to Claim 1, wherein the antenna elements are formed as chip antennas having element tips extending in a common direction as viewed from within the ground pattern, and wherein the ground pattern is formed such that a space is provided in the direction of the element tip of each of the chip antennas.

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5 (original): A diversity antenna apparatus according to Claim 1, wherein the substrate further comprises a hybrid pattern that is connected to at least two of the plurality of antenna elements.

6 (original): A diversity antenna apparatus according to Claim 5, wherein the substrate is composed of a lamination of a hybrid layer including the hybrid pattern, a connecting layer including a connecting pattern for connecting the hybrid pattern to an external port, and a ground layer including the ground pattern, and wherein the ground pattern is arranged between the hybrid layer and the connecting layer to form a microstrip-line structure, and shares the ground layer with the plurality of antenna elements.

7 (currently amended): A diversity antenna apparatus comprising:

a plurality of antenna elements disposed on a substrate, among which switching is allowed; and

a ground pattern formed in or on the substrate, the ground pattern functioning together with each of the plurality of antenna elements;

wherein the ground pattern is formed at a central region of the substrate with a gap from each of the antenna elements, wherein the antenna elements are disposed on the substrate so as to surround the ground pattern, and wherein the ground pattern and the antenna elements are disposed in parallel to a mounting surface of the substrate,

wherein the ground pattern has at least one side edge along which at least two of the antenna elements are disposed with tips thereof directed in the same direction and with spaces provided adjacent to and in the directions of the respective tips of the antenna elements.

8 (currently amended): A diversity antenna apparatus comprising:

a plurality of antenna elements disposed on a substrate; and

a ground pattern formed in or on the substrate, the ground pattern functioning together with each of the plurality of antenna elements;

wherein the ground pattern is formed at a central region of the substrate with a gap from each of the antenna elements, and wherein the antenna elements surround the ground pattern,

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wherein the plurality of antenna elements comprises an antenna element dedicated for transmitting and an antenna element dedicated for receiving,

wherein the ground pattern has at least one side edge along which at least two of the antenna elements are disposed with tips thereof directed in the same direction and with spaces provided adjacent to and in the directions of the respective tips of the antenna elements.

9 (original): A diversity antenna apparatus according to Claim 8, wherein the antenna element dedicated for transmitting functions as a vertically polarized antenna.

10 (original): A diversity antenna apparatus according to Claim 8, wherein the ground pattern comprises a first region that functions as a ground for the antenna element dedicated for transmitting and a second region that functions as a ground for the antenna element dedicated for receiving.

11 (original): A diversity antenna apparatus according to Claim 10, wherein the first region extends in a vertical direction.

12 (currently amended): A diversity antenna apparatus comprising:

a plurality of antenna elements disposed on a substrate; and

a ground pattern formed in or on the substrate, the ground pattern functioning together with each of the plurality of antenna elements;

wherein the plurality of antenna elements comprises an antenna element dedicated for transmitting and an antenna element dedicated for receiving,

wherein the ground pattern has at least one side edge along which at least two of the antenna elements are disposed with tips thereof directed in the same direction and with spaces provided adjacent to and in the directions of the respective tips of the antenna elements.

13 (original): A diversity antenna apparatus according to Claim 12, wherein the antenna element dedicated for transmitting is a vertically polarized antenna element.

14 (currently amended): A diversity antenna apparatus comprising:

a plurality of chip-type antenna elements disposed on a plane of a substrate;

a ground pattern formed in or on the substrate substantially in parallel with the plane to establish an electromagnetic coupling with the antenna elements, wherein all of the antenna elements are disposed outside an outer periphery of the ground pattern; and

a connecting pattern formed in or on the substrate which is connected to the antenna elements to conduct switching among the antenna elements for diversity control,

wherein the ground pattern has at least one side edge along which at least two of the antenna elements are disposed with tips thereof directed in the same direction and with spaces provided adjacent to and in the directions of the respective tips of the antenna elements.

15 (original): A diversity antenna apparatus according to Claim 14, wherein the antenna elements are disposed along the outer periphery of the ground pattern.

16 (original): A diversity antenna apparatus according to Claim 15, wherein the antenna elements are directed in the same general direction along the outer periphery of the ground pattern.

17 (original): A diversity antenna apparatus according to Claim 15, wherein the antenna elements are disposed along the outer periphery of the ground pattern which are opposed to each other.

18 (original): A diversity antenna apparatus according to Claim 14, further comprising a hybrid pattern formed in or on the substrate connecting one antenna element to another.

19 (original): A diversity antenna apparatus according to Claim 14, wherein the ground pattern is comprised of a segment for transmitting and another segment for receiving, which are separated from each other, wherein at least one antenna element is dedicated for transmitting, and at least one antenna element is dedicated for receiving.

20 (original): A diversity antenna apparatus according to Claim 17, wherein the segment of the ground pattern for transmitting is such that the antenna element for transmitting serves as a vertically polarized antenna element.

21 (new): A diversity antenna apparatus according to Claim 1, wherein the ground pattern has another side edge along which at least two of the antenna elements are disposed with tips thereof directed in the same direction and with spaces provided adjacent to and in the directions of the respective tips of the antenna elements.